THE BRITISH TRANSANTARCTIC EXPEDITION

George Lowe

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of light which glimmer in the polar skies and seem to shift and to change colour rather like gigantic cinema curtains. Radio also suffers because the ground stations are often sited at mining fields, solely to lead aircraft up from the south. To the north, they may be badly screened and may give inaccurate results.

Radar, like visual position finding, is not easy. Broken ice may show up bright, whereas smooth ice may hardly show up at all. At sea, a large iceberg may be almost invisible if its surface is smooth and canted so that the radar waves are reflected away, whereas a small iceberg, with an overhanging lip, may show up very brightly.

Astro suffers from the difficulty that, although the stars will be up all through the polar winter, only the Sun will generally be visible during the polar summer. The Moon will either be so close to the Sun as to be practically invisible against the violet arctic haze, or else below the horizon. We can only expect Sun and Moon fixes on half a dozen days in each summer month. Astro, however, does have one advantage. At the north pole, a body which is overhead at the equator will be on the horizon. In other words, if the declination is 0, the altitude is 0. Hence declination gives altitude, just as hour angle gives grid azimuth, though once again we shall need a method of correction if we are some distance from the pole itself.

We have taken a brief look at the problems of polar navigation in the hope that they may help us to a better appreciation of some of the fundamentals of navigation in normal latitudes.

But the ice and the snow of the polar regions surely means much more than this to you. Many polar expeditions have been led by sea captains and many seamen have served in them with great gallantry. Indeed, it is natural that men who take up the challenge of the seas should take up the challenge of the poles.

II—The British Transantarctic Expedition

George Lowe
(Commonwealth Transantarctic Expedition)

Captain Scott went to the pole over the Ross Barrier, up the Beardmore Glacier (Fig. 1) which is about 100 miles long, and then on to the south pole, coming out by the same route. The great Norwegian explorer Amundsen went in from the other side over the shelf, up one of the glaciers and on to the pole. Admiral Byrd flew in and out again in 1929. Apart from these expeditions very little has been done in Antarctica and nearly all of it, apart from the fringe, is untouched.

The object of our expedition is to cross Antarctica. It has not been done before, but has been tried twice. Each time it came to grief before

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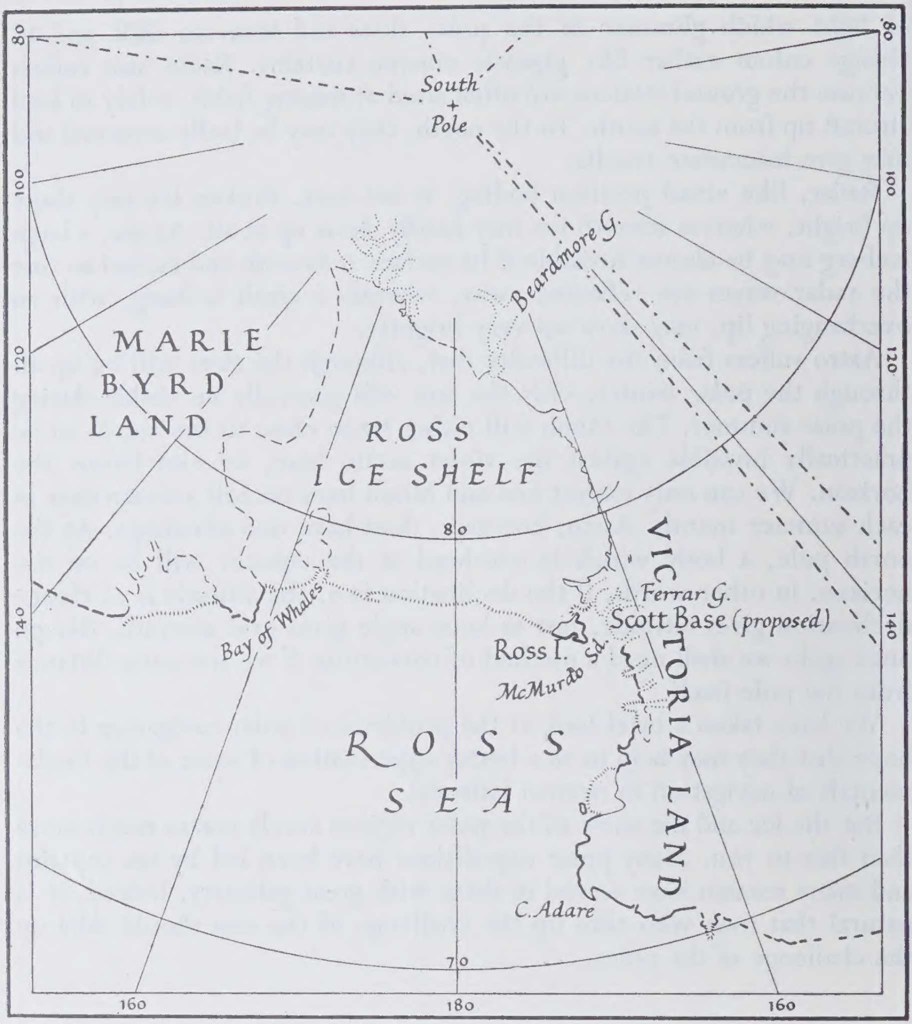

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Fig. 1. The Ross Sea and Scott Base.

reaching the actual continent. The first time, a German called Filchner sailed down in 1910. He had put the idea up to the German Geographical Society but they would not give him support for a trans-continental journey. However, he was determined to walk inland so he sailed down in his small ship, penetrated the Weddell Sea (Fig. 6), and got to the continent. The continental shelf is a great cliff and from there you can look inland over the ascending ice. He climbed up and found what he thought was the ideal place for his hut. He had the framework up and was just putting on the roof when his ideal site was found to be an iceberg slowly going out to sea. So he pulled his hut down and got it back on board his ship, was beset—stuck in the ice—and was there for some months. He slowly drifted north, away from the continent. His wooden

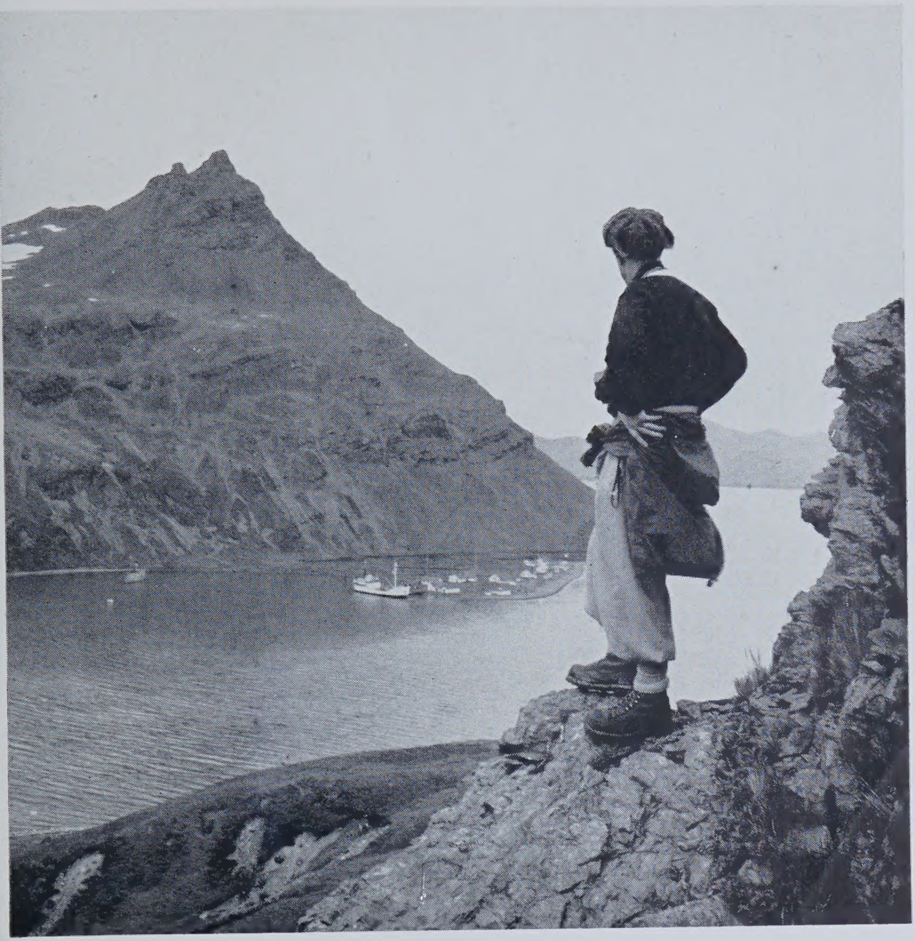

Fig. 2. Sir Edmund Hillary looking down on m.v. Theron *at South Georgia.*

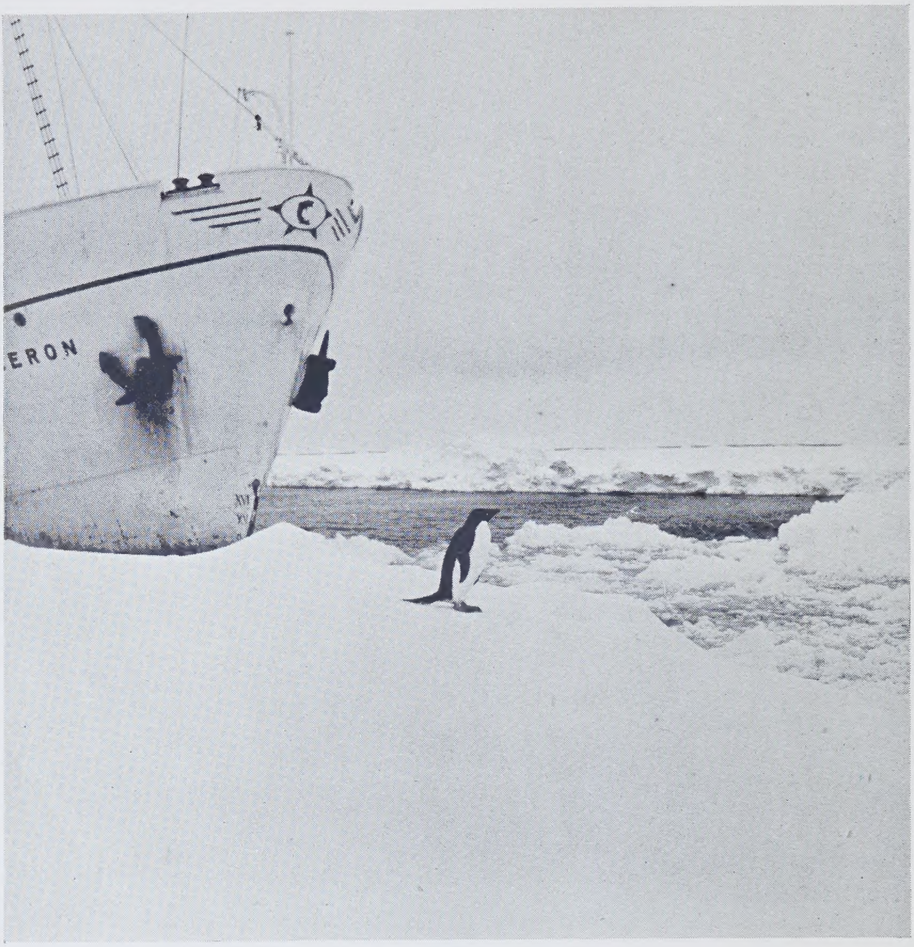

Fig. 3. M.v. Theron *in pack-ice.*

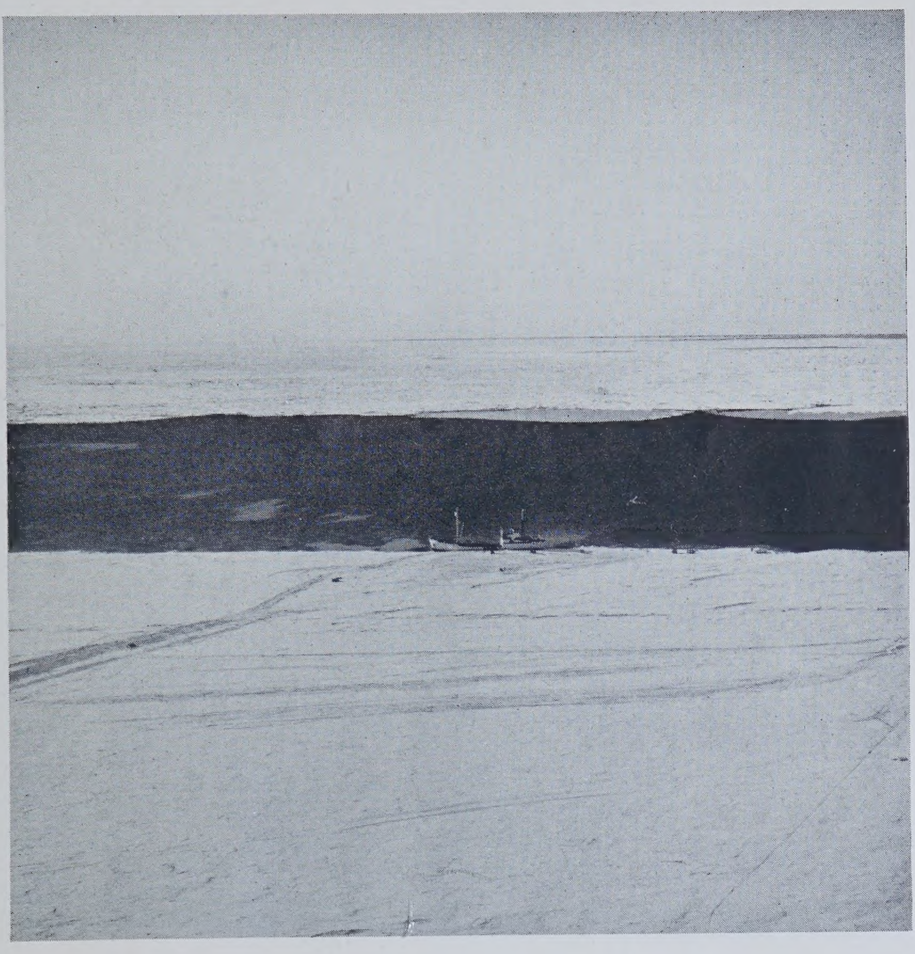

Fig. 4. M.v. Theron *at the ice edge, with pack-ice beyond.*

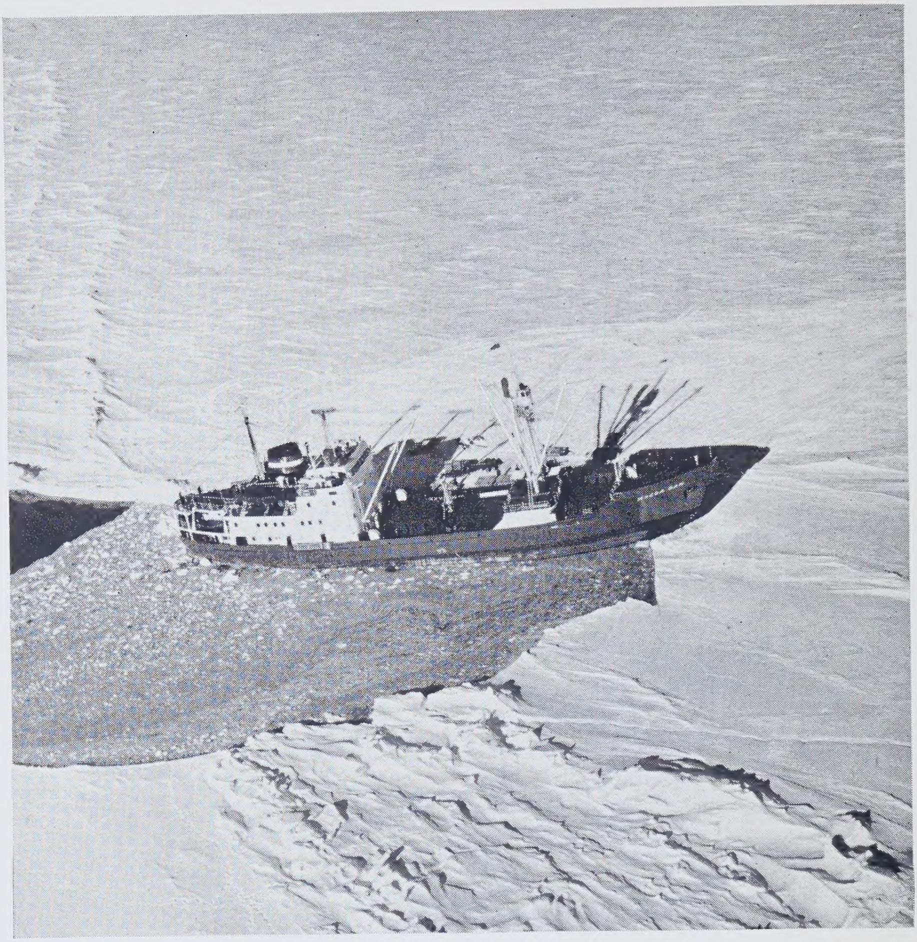

Fig. 5. Magga Dan *at Shackleton.*

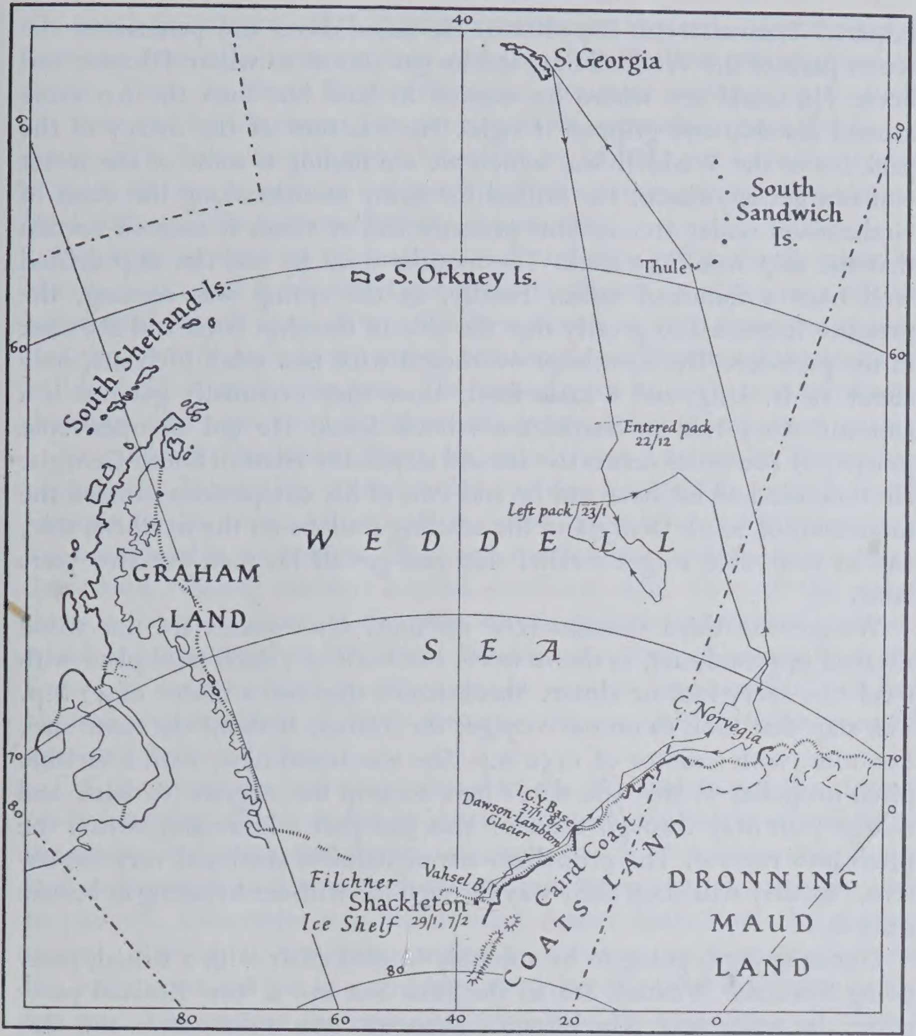

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Fig. 6. The Weddell Sea and Shackleton Base.

ship came under great pressure; he thought at times it would be sunk, but it was not. It was very badly twisted and buckled but he managed to break free and limped his way back to Germany. A short while ago a letter arrived at our office which came from Switzerland, written in rather a shaky hand by Filchner himself. He said he had his diaries and maps and that perhaps they would be of some use to us and he would send them over when they had been translated.

The second attempt was in 1914, just as the First World War was breaking out. Shackleton's ship, the *Endurance*, a little wooden sailing ship with an auxiliary motor of 45 h.p., sailed out to try to establish a base on one side of the continent, while another of his ships set out from New Zealand to go to the other side. He called his expedition the

Imperial Transantarctic Expedition. He sailed down and penetrated the worst pack of the Weddell Sea, and he got almost to where Filchner had been. He could see where he wanted to land but then the ice came around his ship and gripped it tight. He was now at the mercy of the pack-ice of the Weddell Sea, which we are finding is some of the worst you can get anywhere. He drifted for many months along the coast of Grahamland under tremendous pressure and at times it seemed certain that the ship would be sunk. The months went by and the ship drifted well over a thousand miles. Finally, as the spring was coming, the pressure increased so greatly that the side of the ship burst and she sank in the pack-ice. The men leapt overboard with two small lifeboats, only about 16 ft. long, and a little food. How they eventually got out is a fantastic story told in Shackleton's book *South*. He did an open boat journey of 800 miles across the sea and struck the coast of South Georgia. He then ditched his boat and he and two of his companions crossed the mountains of South Georgia to the whaling stations on the northern side, and so were able to get a relief ship and get all his men out two years later.

We are the third transantarctic attempt. Our vessels are not wood sheaved in greenheart, as theirs were, but built of ¾-inch steel plate with steel ribs every foot or closer. Shackelton's ship had a motor of 47 h.p. The ship that took us on our voyage, the *Theron*, is about the same size, 800 tons, with a motor of 1350 h.p. She was brand new, with a variable pitch propeller so that you don't have to stop the engines to back and charge your way through the ice. You just pull a lever and switch the pitch into reverse. The propellers are of stainless steel and very expensive, but they will chop their way through ice without breaking as bronze ones do.

Our crossing is going to be a double-headed affair with a British party going from the Weddell Sea to the Ross Sea and a New Zealand party going the other way. The distance is about 2000 miles across and that requires a lot of organization. In three weeks time, the British party leaves for a point near Vahsel Bay in the Weddell Sea, which we shall call Shackleton Base (Fig. 6), arriving in January of 1957. In December 1956 a ship leaves New Zealand, with a party led by Sir Edmund Hillary, and sails to Scott's old base. He is going to try to make his way up one of the glaciers, almost certainly the Ferrar Glacier (Fig. 1), and break out over the Victoria Land mountains and get on to the polar plateau, which is pretty well unmapped. The reason for not using Scott's route is that the Beardmore Glacier is 100 miles long, is very crevassed, pretty broken up and very difficult. He will want to use vehicles and we don't think we can get vehicles up and down the Beardmore Glacier.

Sir Edmund's party will go over the mountains, which are 15,000 feet high, doing surveys as they go, up to the point called Depot 300, which is 300 miles inland; they hope to establish quite a big depot there. At the same time, we shall establish our own Depot 300. Then, during the southern winter—that is next summer in England—if you have a summer—we will be at our base and the New Zealand party will be at theirs. Then, in about November 1957, we start working up towards the pole and by Christmas Day we should be somewhere near the South Geographic Pole. At this point I hope to be looking out over the wastes of snow and see a great big tall gangling figure coming along, stick out my hand and say, 'Sir Edmund Hillary, I presume?'

We hope to meet up by January 1958 and then get to the far coast by March 1958; and if we don't get there by March 1958 we may not be home until March 1959. If we miss by a month or two, there is a chance that the ice will pack in around us and the ship will either have to go or will be held there for the year. The timing must be fairly neat otherwise the ships won't get away at either end, because it is a very short season.

To establish Shackleton Base we sailed from London in November 1955 in the *Theron* (Fig. 3) and rolled our way southwards towards South Georgia in the South Atlantic. It is called the gateway to Antarctica. It has considerable mountains, is only 60 miles long and there are three shore-base whaling stations on the northern side. One of the sights there is the small cross, at the point as you go into Gritwycken harbour, which is a memorial to Sir Ernest Shackleton. After his escape from the *Endurance*, he went back to Antarctica in 1922 to have another look but he died very suddenly in South Georgia—he was only forty-six years of age—and is buried there.

On the island we had many things to do. We had to get the aircraft ready for flying. It was sealed in plastic and we broke this open and fitted the wings, did some test flying and made it ready. It has a long-range tank underneath so that with floats and two heavy men it has quite a lot to pull off. Otherwise it is an ordinary Auster apart from the starting system. Starting at low temperatures is not easy, so they stripped out the self-starter and put in a cartridge start that was used in fighters in the last war. You put six shot-gun cartridges into the magazine and, instead of pressing a button, you pull a trigger which fires a shot and kicks over the motor. It worked exceedingly well, but you take the shot out of the cartridge for a start! We reckon that this little plane will do all that a helicopter will except to land and take-off in a small space; and the main reason against a helicopter is that it costs £55,000.

We shall now leave all this and get down into the ice. We struck the ice after leaving South Georgia in 63° south, though at this latitude in the north you aren't anywhere near ice. Just before Christmas Day, it got thicker and on Christmas Day itself we crossed the Antarctic circle and were in continual daylight. Then things got much more difficult. The currents changed and the wind increased and began to twist up the areas of pack ice in which we were moving and closed up all the leads down which we were trying to work. The ship was being used like a big axe, chopping its way from one pool to the next.

The ice of the Antarctic caught our ship and twisted us in with nothing but miles and miles of pack-ice around us. The ship had tremendous pressure on her. We had a great many of our plates buckled and we broke over fifty of our steel ribs while we were in the ice. We sat for a month, jammed tight and the problem was trying to move ourselves. We used digging and dynamiting methods. The idea was to try to get a bit of free water along the side and, once you had got free water, there was a chance of dynamiting and shaking the ship free. The thickness of the ice was enormous and we found that just dynamiting was not enough when there was such a tremendous pressure. We placed our dynamite on long 20-ft. pine logs, right down deep in the water dead in line with the bow. We used clusters of 12 or 15 sticks and got a tremendous impact and really were shifting things. One of our shots split the bow nine inches below the sea-surface, about 3 ft. below this waterline, and fouled up one of our fresh-water tanks and we had to load fresh water.

We spent 30 days in the ice trying to break free. We only shifted her about 20 miles by our own efforts, and drifted about 270 miles, so that the ice was having the last say in everything that we did.

You get quite used to the fact that you are on a thick skin and are able to walk on it although the depth is about 2000 fathoms, and you get quite careless of it. The ice buckles up and there is a lot of twisting and we couldn't take our aircraft off because the runways, or the possible runways, for skis were always blocked by big pieces in the way.

We finally turned north and fought our way out the way we had come into the ice, and we broke north after a tremendous struggle, and a very exciting one. We managed to get a flight in our plane so that we got an idea of where we were. At the same time H.M.S. *Protector*, a naval vessel, came down to try and give us assistance. She had two helicopters on board and they found us when we were making our way north having pretty well broken free, but we did thank them for the assistance that they offered.

Fig. 6 shows where we entered the pack and how we wriggled around in it and finally broke out and then got down to the point where we were to establish our base. We found our way through the pack with our radar and our aircraft spotting the leads. We then headed off down the Antarctic coast. We passed many icebergs, one of them was just over 40 miles long. These things are huge ice islands which break off from the continental shelf.

Fig. 4 is taken from the air and shows a lead right along the coast. On the right hand side, you can see the Antarctic continent with sea-ice, as we call it, fastened against the cliff, against which we were to put our ship and unload our stores and run them across so that we could get up on to the actual cliff. We established Shackleton base almost at latitude 78° south and that is where the unloading began.

We shall have 24 dogs down there, for light reconnaissance and as an insurance policy if things go wrong. But we shall mainly use vehicles. The Snow-cat is an unusual vehicle with four tracks instead of two, all separately slung. It travels over snow sitting on the pontoons with the tracks to give forward traction. They press less lightly than a person on skis, about 1·2 lb per square inch. But the big problem is that they only do 1·4 miles to the gallon. A Weasel, however, does about 2 miles to the gallon and pulls sledges like the Snow-cat. Altogether, we shall have eight or nine vehicles as well as our dogs and, in the vehicles, there will be some pretty sizeable gear, depth sounding and gravity-measuring equipment and so on. We have got 2000 miles to go in our crossing and about 15,000 vehicle miles to go in laying our bases, so you can see something of our loading problems in fuel.

It was here that we put the Auster on skis and did long reconnaissance flights. The conditions varied a good deal and we found that the sea was beginning to freeze around us as well as the pack ice drifting into us. We had to move out, and this we did on 7 February. We left eight people behind, who are down in the Antarctic still. They have had a very hard time during the winter, but they are in contact by radio and we hope to get back to them early in January.

We dashed our way back from the Antarctic through the Atlantic, through Montevideo, to Madeira and back into London which we reached in March 1956. That was the first part over. The second part starts three weeks after this lecture and we have been organizing like mad all this year. We leave in the *Magga Dan*, a ship built in Copenhagen and launched in June. She is 1800 tons, more than twice the size of *Theron*, but we need a bigger ship. She has 1-inch steel plates and a variable pitch propeller and although not an icebreaker, she has been specially constructed for travel through ice. There is a very exciting voyage coming up.

All-weather Helicopter Operation

P. A. Hearne

(Helicopter Project Engineer, British European Airways Corporation)

1. Introduction. The operation of helicopters in all weathers is an essential development if full advantage is to be taken of this class of vertical take-off aircraft. Helicopters must operate in weather minima at least as low as the current fixed-wing limits of 300 yards visibility and 300 ft. cloudbase, and should approach the limits approached by surface transport which continues to operate down to visibilities of the order of 10 to 20 yards. Present experience suggests that it should be possible to conduct regular operations down to 200 yards visibility and 200 ft. cloudbase provided the necessary aids are available. As experience is gained, these limits might be reduced to 150 yards and 150 ft. However, as the pilot needs time to change over to visual guidance before landing, it does not seem likely that these limits could be much reduced before the development and acceptance by civil operators of either completely automatic landing or some radical new landing aid.

The prime requirement for future civil helicopter operations and particularly all-weather operations, is a multi-engine helicopter with adequate performance following the failure of one engine. Engine failure in a single-engine helicopter followed by a rapid descent whilst above a low cloudbase constitutes a completely unacceptable risk to the civil operator and licensing authorities. The first generation of multi-engined helicopters should be available in 1960 and will weigh upwards of 15,000 lb. and carry some 18–25 passengers. The second generation of helicopters now under development should carry upwards of 40 people at a cruising speed of 150 kts. over a 200-mile range.

Air traffic control requirements will often force helicopters to fly in icing conditions for appreciable lengths of time. Current research into anti-icing systems includes electric mat, liquid and hot gas methods. It is impossible at this stage to say which will be the most effective. What can be said is that de-icing is essential for civil all-weather operations.

Refinements in design are also necessary to make helicopters suitable for operations in high winds. The ability to start and stop the rotor in strong and gusty winds is important and, unless suitable restrainers are built into the rotor system, the blade motion can be completely uncontrollable whilst starting and stopping in these conditions, and a blade can strike the aircraft and severely damage it. Current aircraft have rotor starting limitations of 30–40 kts., which should be increased to 50–55 kts. for future aircraft.

2. Instrument flying characteristics. To operate any type of helicopter in all-weather conditions, it is necessary to have good instrument flying characteristics, a term which is synonymous with good

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